SDLS02 - Plate mean rhombus clamped with Summarized

edge:

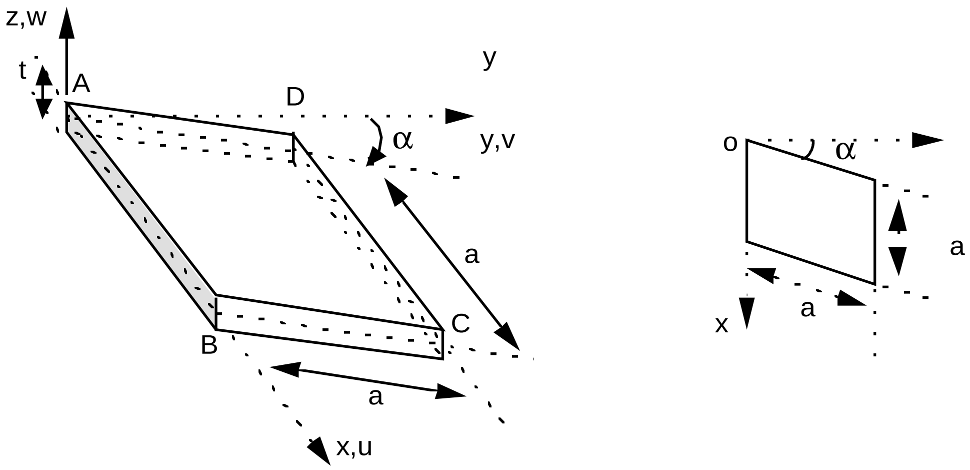
This three-dimensional problem consists in seeking the frequencies of vibration of a mechanical structure made up of a parallelepipedic plate (nonrectangular), embedded on only one side. This test of structural mechanics corresponds to a dynamic analysis of a surface model having a linear behavior. It comprises only one modelization.

This problem makes it possible to test shell element DKT and the computation of frequencies of vibration by the method of Lanczos.

The results got on the first two eigenfrequencies are in concord with those of guide VPCS.

1 Problem of reference

1.1 Geometry



Side $a=1.m$, thickness $t=0.01\,m$, $\alpha=30°$

Coordinated points (in m):

	A	B	C	D
x	0.	a	$a(1+\sin\alpha)$	$a\sin\alpha$
y	0.	0.	$a\cos\alpha$	$a\cos\alpha$
z	0.	0.	0.	0.

1.2 Properties of the materials

$E=2.1\,10^{11}\,Pa$

$\nu=0.3$

$\rho=7800.\,kg/m^3$

1.3 Boundary conditions and loadings

clamped AB Side:

for any point P such as $y_p=0.$

$u=v=w=0.$
$\theta_x=\theta_y=\theta_z=0.$

1.4 Initial conditions

Without object for the modal analysis.

2 Reference solution

2.1 Method of calculating used for the reference solution

the formula of reference is that given in file SDLS02/89 of the guide VPCS which presents the method of calculating in the following way:

The formulation of M.V. BARTON, for a plate on side, led to:

$$f_i = \frac{1}{2\pi a^2} \lambda_i^2 \sqrt{\frac{E\,t^2}{12\rho(1-\nu^2)}} \quad i=1,2,\dots$$

where: $\lambda_i^2 = g(\alpha)$

with, for a Poisson's ratio $\nu=0.3$ and $\alpha=30°$:

	$\alpha=30°$
λ_1^2	3.961
λ_2^2	10.19

- M.V. Barton mentions the sensitivity of result to the order of the mode and the angle α .
- This reference solution applies to the thin plates such as: $t/a<0.1$.
- The coefficients λ_i were established with a restricted development of an insufficient nature.

2.2 Results of reference

the first two eigen modes given by:

- the formula of M.V. Barton,
- the average of 5 software packages of computation by the finite element method.

2.3 Uncertainty on the semi-analytical

solution Solution $< 2\%$.

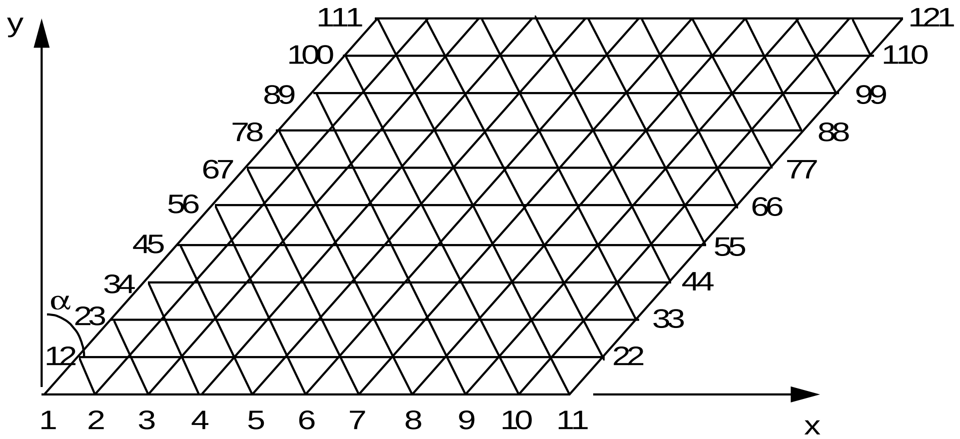
2.4 Bibliographical references

1) M.V. BARTON, Vibrations of rectangular and skew cantilever punts. Newspaper of Applied Mechanics, vol. 18, p. 129-134 (1951).

3 Modelization A

3.1 Characteristic of modelization

DKT



Cutting: 10 on each side of the rhombus is 200 meshes `TRIA3`.

Limiting conditions:

in all the nodes on the side AB :

```
DDL_IMPO: (GROUP_NO: AB DX: 0. , DY: 0. , DZ: 0. , DRX: 0. , DRY: 0. ,
DRZ: 0.)
```

Name of the nodes:	Not A = $N1$	Not C = $N121$
	Bridge B = $N11$	Not D = $N111$

3.2 Characteristic of the mesh

Many nodes:	121
Number of meshes and types:	200 `TRIA3`

3.3 Quantities tested and Order

results of the Frequency proper I	mode (Hz)			
	Reference (Barton)	Reference (average of 5 codes)	*Aster*	% difference averages codes
1	9.8987	9.7355	9.8402	1.08
2	25.4651	23.2745	23.5790	1.31

3.4 Remarks

Computations carried out by:

```
MODE_ITER_SIMULTMETHODE    : 'TRI_DIAG
                              OPTION: ' PLUS_PETITE'NMAX_FREQ: 2
```

3.5 Contents of the file results

the first 2 modal eigenfrequencies, eigenvectors and parameters.

4 Summary of the results

the results given by *Code_Aster* are comparable to the results given by other using computer codes of the formulations different for this plate in the shape from parallelogram.